1.0 Given that the modulus of elasticity of steel is 30,000,000 psi, how much will a wire 0.1 in in diameter and 10 ft long be deflected when it supports a load of 1100 lb?

\[ \varepsilon = \frac{\Delta}{E} = \frac{1100 / (\pi/4)(0.1)^2}{30,000,000} = 0.0047 \text{ in/in} \]

Deflection = \( (0.0047 \text{ in/in}) \times (120 \text{ in}) = 0.56 \text{ in} \)
2. A length of 0.50 ft diameter (1/16 in) wire is stretched between supports that are 6 ft apart as drawn below. When a weight of 6.0 lbs is suspended from the wire, its center deflects 4.69 in. The deflection limit for the wire is .06 in. and .03 in. Find the modulus of the wire in the wire and find

a. Stress in the wire

b. Stress in the wire at the point of attachment:

\[ F_{W} = F_{N} \]
\[ \frac{F_{W}}{F_{N}} \]
\[ F_{N} \]
\[ 0.000 \]
\[ F_{N} + F_{W} = 1.00 \]
\[ F_{N} + F_{W} = 2 \times 6 = 6000 \text{ lbs} \]
\[ \frac{36}{6} \]
\[ \frac{-49}{6} \]
\[ \theta = 0.12 \rightarrow \theta = 7.22^\circ \]
\[ F_{N} = 6000 \text{ lbs} \cdot \sin(\theta) \]
\[ F_{N} = \frac{6000 \text{ lbs}}{31.4} = 46.46 \text{ lbs} = F_{W} \]
\[ F_{W} = \frac{94.46 \text{ lbs}}{\pi (0.04)} \text{ in} \]
\[ 227.355 \text{ psi} = (F_{W}) \]

b. Total elongation

The elongation of a wire under load is \( \frac{36}{6}, 6 \text{ ft} = 36.36^\circ \)

Total elongation is \( (2 \times 36.36^\circ) = 72^\circ \) = 9.608 \text{ in} = \text{Elongation}

\[ E = \frac{94.46 \text{ lbs}}{6} \]
\[ 0.009 \text{ in}/72^\circ = 26.9 \text{ ksi} = \text{E} \]
3. A copper wire has a nominal breaking strength of 43,000 psi, and a reduction in area of 77%. Calculate:

a. The true tensile strength (breaking load/true area).

b. The true strain, $\varepsilon_{true}$, at the point of fracture (the instantaneous strain $\varepsilon$ is equal to $dA/A$).

\[
\frac{F}{A_0} = 43,000 \text{ psi} \Rightarrow F = 43,000 A_0 \\
F = \frac{F}{A_0} = \frac{43,000 A_0}{(1-0.77)A_0} = \frac{43,000 A_0}{0.23 A_0} = 187,000 \text{ psi} \\
\]

\[
b. \quad \frac{d\varepsilon}{d\varepsilon} = \frac{dA}{A} \\
\varepsilon_{true} = \int \frac{dA}{A} = \ln \frac{A_0}{A_f} \\
\Delta A = A_0 - A_f = A_f \Delta \varepsilon \\
\varepsilon_{true} = \ln \frac{A_0}{A_f} = \ln \frac{A_0}{(0.23)A_0} = 1.47 \text{ or } 147% \]
THE OBJECT PICTURED BELOW IS A GLASS PLATE 2 ft SQUARE AND \( \frac{1}{4} \) IN THICK. HOW LARGE A FORCE \( F \) MUST BE EXERTED ON EACH EDGE IF THE DISPLACEMENT \( x \) IS 0.01 in? USE \( E_{glass} = 5 \times 10^6 \) psi.

\[ \text{SHEARING STRESS} = \frac{F}{A} = \frac{F}{(24)(\frac{1}{2})^2} = \frac{F}{6} \]

\[ \text{SHEARING STRAIN} = \frac{x}{h} = \frac{0.01}{0.25} = 0.04 \]

\[ 
\sigma = \frac{F_{max}}{F_{min}} = 5 \times 10^6 \times \frac{F/6}{0.004417} 
\]

\[ F = 12, 510 \text{ lb} \]